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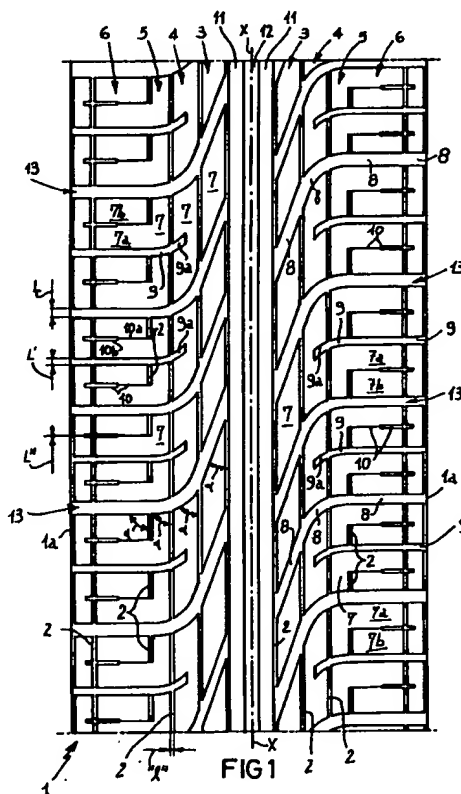
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I-20126 Milano (IT)**(54) **Tyre for motor-vehicle wheels provided with a tread producing a low rolling noise.**

(57) A tread for motor-vehicle tyres has a raised pattern formed of a plurality of shaped blocks (7) distributed according to circumferential rows (3, 4, 5, 6) disposed parallelly in side by side relation. The number of the shaped blocks (7) arranged in each row gradually increases on passing from the equatorial plane (X-X) to the side edges (1a) of the tread (1). Thus a gradual increase in the longitudinal stiffness of the shaped blocks (7) is achieved on passing from the side edges (1a) of the tread (1) to the equatorial plane (X-X), which brings about a reduction in the mobility of said blocks on the imprinting area and a greater quietness of the tyre in use.

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The present invention relates to a tyre for motor-vehicle wheels provided with a tread producing a low rolling noise, which comprises a raised pattern formed of a plurality of shaped blocks distributed in parallel circumferential rows bounded by longitudinal grooves extending circumferentially of the tyre and each comprising a given number of shaped blocks separated from each other by respective transverse cuts.

It is known that tyres for road motor-vehicles have a plurality of longitudinal grooves and transverse cuts on the tread, which define a plurality of shaped blocks thereon, said blocks being distributed according to a specific pattern suitably studied.

Within said pattern the longitudinal grooves by effect of which the shaped blocks are distributed in several side by side rows, give the tyre the desired features of directional control stability and roadholding in relation to the drift thrusts directed parallelly of the wheel axis. The transverse cuts, in turn, give the tyre the desired tractive features, that is the capability of efficiently transmitting the tangential thrusts parallel to the running direction during the speeding up and slowing down steps of the vehicle. In principle, the tractive power of the tyre tends to become greater as the number of the transverse cuts arranged in the tread increases and the orientation of the cuts themselves approaches the perpendicular to the running direction.

In addition, the longitudinal grooves and transverse cuts cooperate in performing an efficient draining action of the water from the imprinting area of the tyre during the running on a wet road-bed.

The presence of the transverse cuts and longitudinal grooves however causes the well known effect of noise produced by the tyre rolling. In greater detail, one of the main causes of the rolling noise has been found in the continuous succession of impacts of the shaped block corners on the road-bed.

Another contributory cause in generating noise is given by rubbings that the shaped blocks undergo in contact with the road-bed when they enter and leave the imprinting area. These rubbings are essentially due to the deformations necessarily undergone by the tread, in that its outer surface which in a free state has a convex conformation with a double bending, as known, inevitably becomes flat against the road-bed.

The dynamic actions causing the deformation of the tread between the entry and exit regions to and from the imprinting area also give rise to a cyclic volumetric variation of the grooves and cuts defined between the shaped blocks, which brings about a cyclic compression and decompression action on the air contained in the grooves and cuts.

These phenomena of air compression and decompression help in causing the generation of noise produced by the tyre rolling.

The known art suggests several expedients for limiting the noise produced by the tyre rolling as much as possible.

One expedient which has been adopted for a long time essentially consists in differentiating the longitudinal dimensions, that is those along the circumferential extension, of the single shaped blocks. In other words, the blocks are disposed on the circumferential extension of the tread according to two or more differentiated pitch values distributed in a circumferential succession, usually referred to as "pitch sequence" which is generally studied so as to achieve the maximum possible unevenness over the whole circumferential extension. In this manner the pressure waves generated by the impacts and rubbings of the blocks do not take place according to a specific frequency on which most of the acoustic energy generated as a result of rolling would be concentrated. In other words, the acoustic energy is distributed over a wide frequency range, thereby eliminating the troublesome effect of noise usually known as "squirrel effect".

Still for the purpose of distributing the acoustic energy over a greater number of frequencies, it has also been suggested to carry out the offsetting, with respect to each other, of the blocks belonging to circumferential rows disposed consecutively in side by side relation. This solution however makes it difficult to drain the water from the centre of the contact area towards the outer edges of the tread and therefore makes it necessary to increase the width of the longitudinal grooves for achieving a sufficient draining action.

Another expedient consists in giving the transverse cuts a suitably inclined orientation with respect to the perpendicular to the running direction. This enables the impacts of the block corners on the road-bed to be "smoothed" but, on the other hand, it impairs the tractive features of the tyre.

A considerable reduction of the noise produced by rolling has been achieved by forming additional cuts usually referred to as "sipes" in the shaped blocks, said sipes being adapted to increase the elastic deformability of the blocks. This solution too enables the impact of the block on the road-bed to be smoothed, thereby causing a reduction of the noise resulting from impacts. However the greater deformability of a block will tend to increase the noise effects resulting from rubbings.

By way of example of the above described state of the art, please refer to the Italian Patent application No. 20284A/90 in the name of the same Applicant.

In accordance with the present invention it has been found that by arranging in the circumferential rows close to the equatorial plane of the tyre or centre rows, a number of shaped blocks lower than that provided in the rows adjacent to the side edges of the tread or shoulder rows, it is possible to achieve an important reduction of the noise produced by rolling of the tyre without impairing the tractive and direction control features of said tyre and its efficiency in water draining.

In particular, the invention relates to a tyre for vehicle wheels, in particular motor-vehicle wheels, provided with a tread producing a low rolling noise, characterized in that each of said rows has an amount of shaped blocks greater than the amount of shaped blocks present in the row disposed consecutively in side by side relation therewith towards the equatorial plane of the tread, in order to give the tread a gradually increasing longitudinal stiffness from the outer side edges thereof towards said equatorial plane.

Close to the equatorial plane at least one continuous circumferential rib may be disposed, said rib being delimited between two of said longitudinal grooves. Preferably, two of said circumferential ribs are provided and they are symmetrically disposed with respect to the equatorial plane of the tread and mutually separated by a central groove.

According to a further feature of the invention, in each row of said shaped blocks the transverse cuts define an impact angle with the adjacent longitudinal grooves which has a greater width than the impact angle formed with the transverse cuts of the block row disposed consecutively in side by side relation therewith towards the equatorial plane.

In greater detail, the value of the impact angle in the block rows that are closest to the equatorial plane is in the range of  $15^\circ$  to  $25^\circ$ , whereas in the block rows closest to the side edges of the tread said impact angle is in the range of  $70^\circ$  to  $105^\circ$ .

Advantageously, each of said rows has first transverse cuts each extending consecutively of one of the first transverse cuts belonging to the block row disposed adjacently in side by side relation.

Said first cuts consecutively aligned define continuous transverse grooves each extending from the corresponding outer side edge of the tread as far as close to said equatorial plane.

Each of said transverse grooves, starting from the corresponding outer side edge has one straight portion substantially perpendicular to the longitudinal grooves, a curved union portion and a second straight portion disposed obliquely relative to said longitudinal grooves.

In addition, at least one of said block rows has second transverse cuts each of them being intermediate between two of said first cuts.

Preferentially, the second cuts are associated with outer shoulder rows, adjacent to the outer side edges of the tread, and inner shoulder rows disposed side by side with the outer shoulder rows towards the equatorial plane.

Each of said second cuts is spaced apart a varying distance from the first cuts contiguous therewith and has a lower width than the first cuts. In particular, the ratio between the width of the second cuts and that of the first cuts is in the range of 50% to 100%.

It is also provided that the blocks of at least one of said rows should each have at least one transverse slot extending towards said equatorial plane over a portion of lower width than the width of the block itself, in the extension of one of said second cuts. Said transverse slots are preferentially associated with outer centre rows disposed consecutively and side by side with the inner shoulder rows towards the equatorial plane of the tread.

Each of said transverse slots extends over about half the width of the respective block.

At least one of said block rows further comprises third cuts extending parallel to said first and second transverse cuts. In greater detail, said third transverse cuts are associated with outer shoulder rows adjacent to the outer side edges of the tread.

Advantageously, the longitudinal grooves separating the outer shoulder rows from the block rows contiguous thereto are interrupted in the portions included between each of the third cuts and one of the first and second contiguous cuts.

The third cuts preferentially have a lower width than said first and second transverse cuts. In greater detail, along the extension of each of said third cuts there is defined an inner portion facing said equatorial plane and having a width lower than 1 mm and an outer portion of greater width than the inner portion.

Further features and advantages will become more apparent from the detailed description of a preferred embodiment of a tread pattern producing low rolling noise, in particular for motor-vehicle tyres, according to the present invention, given hereinafter by way of non-limiting example with reference to the accompanying drawings, in which:

- Fig. 1 shows the plan extension of a tread portion in accordance with the present invention;
- Fig. 2 is a graph showing the variation in the longitudinal stiffness of the tread in question at different points of its transverse extension;
- Fig. 3 is a diagram showing the variation in the number of shaped blocks provided in the different circumferential rows disposed consecutively in side by side relation along the transverse extension of the tread.

Referring to the drawings, a tread producing a low rolling noise in particular for motor-vehicle tyres in accordance with the present invention has been generally identified by reference numeral 1.

The tread 1 conventionally has a plurality of longitudinal grooves 2, spaced apart a suitable distance from each other and extending in a circumferential direction relative to the tyre with which the tread is associated. Such grooves 2 define on the width of the tread 1, a plurality of circumferential rows 3, 4, 5, 6 disposed parallelly in side by side relation and extending circumferentially of the tyre and each comprising a given number of shaped blocks 7. 7a, 7b separated from each other by respective transverse cuts suitably oriented relative to the longitudinal grooves 2.

In accordance with the present invention, advantageously each of the circumferential rows 3, 4, 5, 6 has an amount of shaped blocks 7, 7a, 7b greater than the amount of blocks present in the row disposed side by side and consecutive thereto towards the equatorial plane of the tread 1 denoted by line X-X in Fig. 1. In other words, the number of blocks 7, 7a, 7b present in each row 3, 4, 5, 6 gradually increases on passing from the central area towards the side edges 1a of the tread 1.

This expedient enables the tread 1 to acquire a longitudinal stiffness gradually increasing from the outer side edges thereof towards the equatorial plane X-X, for the purposes to be clarified in the following.

The Applicant has observed that the variation in the number of blocks present in adjacent rows produces considerable effects in the finished tyre and during its use when the number of block rows on each centre line of the tyre is not lower than 3 and preferably not higher than 5.

In the particular embodiment shown referring to a prototype tyre measuring 205/50-R-15, at the equatorial plane X-X of the tread 1 it is provided that the number of blocks 7 be substantially zero, as at least one circumferential continuous rib 11 is located at said area, said rib being delimited between two of said longitudinal grooves 2. In particular, the presence of two circumferential ribs 11 disposed symmetrically of the equatorial plane X-X is preferably provided, said ribs being mutually separated by a centre groove 12 having substantially the same width as the individual ribs 11. Obviously, as the axial sizes of the tyre increase, there may be also an increase in the number of said ribs, although preferably said number should never be higher than three.

Extendingly of each rib 11, that is moving away from the equatorial plane X-X, there is an inner central row 3, an outer central row 4, an inner shoulder row 5 and an outer shoulder row 6, said rows being disposed consecutively in side by side

relation.

Each of said rows 3, 4, 5, 6 has first transverse cuts 8 each of which, advantageously, consecutively face one of the first transverse cuts 8 belonging to the adjacent row or rows of shaped blocks disposed in side by side relation therewith.

Practically, the first transverse cuts 8 as a whole define continuous transverse grooves 13 each extending from the corresponding outer side edge 1a of the tread 1 until close to the equatorial plane X-X and more particularly until close to one of the circumferential ribs 11. This solution advantageously enables the width of the longitudinal grooves to be limited to advantage of the tractive features of the tyre, the water draining action during a running on a wet road-bed relying on the transverse grooves 13 that exhibit an extension substantially devoid of interruptions thus allowing the water to easily flow towards the outer side edges of the tread 1.

In the connection, as can be viewed from Fig. 1, the longitudinal grooves 2 have a lower width than the first transverse cuts 8 and the transverse grooves 13 generated by said transverse cuts 8. In greater detail the ratio between the width "I" of the longitudinal grooves 2 and the width "L" of the first transverse cuts 8 is provided to be included between 0.6 and 0.2 and preferably corresponds to 0.4.

In addition, each of the transverse grooves 13 starting from the corresponding side edge 1a should exhibit one straight portion substantially perpendicular to the longitudinal grooves 2 and extending close to the respective shoulder rows 5, 6, one curved union portion extending close to the outer central row 4 and a second straight portion disposed obliquely of the longitudinal grooves 2 and located close to the inner central row 3.

As regards said straight portion, in its axially outermost section that is the section decreasing towards the tyre sidewall, it can take an inclination greater than 90° relative to the equatorial plane of the tyre, even if said inclination preferably should not be higher than 105°.

In conclusion, due to the arrangement of the transverse grooves 13, in each block row 3, 4, 5, 6 the transverse cuts 8 form with the adjacent longitudinal grooves 2, an impact angle "α" the amplitude of which is greater than that of the impact angle formed with the transverse cuts 8 of the block row disposed consecutively in side by side relation towards the equatorial plane X-X.

In other words, the impact angle "α" of the blocks 7 present in the different rows 3, 4, 5, 6 gradually increases from the equatorial plane X-X towards the outer side edges 1a of the tread.

In more detail, the value of the impact angle α in the inner central rows 3 closest to the equatorial

plan X-X should be in the range of 15° to 25°, whereas the value of the impact angle  $\alpha$  in the outer shoulder rows 6 closest to the side edges 1a of the tread 1 should be in the range of 70° to 105°.

In the embodiment shown, the value of the impact angle  $\alpha$  gradually increases moving away from the equatorial plane X-X, from 20° at the inner centre rows 3, to 90° at the outer 6 and inner 5 shoulder rows.

In addition one or more of the block rows, in the embodiment shown the outer 6 and inner 5 shoulder rows, should be provided with second transverse cuts 9 each of them being intermediate between the first cuts contiguous thereto and spaced apart a varying distance therefrom.

This varying distance enables suitable pitch sequences, which are as much as possible uneven, to be defined on the tread, for the purpose of reducing the tyre noise to the greatest degree, as already said.

Preferably the second transverse cuts 9 have a lower width "L'" than the first cuts 8. More particularly, the ratio between the width of the second cuts 9 and the width of the first cuts 8 is in the range of 50% to 100%, and preferably corresponds to approximately 70%.

The presence of the second transverse cuts 9 in the shoulder rows 5, 6, doubles the number of blocks 7, 7a, 7b defined therein by the first cuts 8.

In the connection it is apparent that the ratio between the block number in two side by side block rows varies on varying of the number of the additional cuts (second transverse cuts 9) intermediate between the main cuts (first transverse cuts 8), so that said ratio can be made different from two, if convenient, by increasing or decreasing the number of said additional cuts, even in a different manner, between the different pairs of main cuts.

Transverse slots 9a stretch out in the extension of the second cuts 9 in the blocks 7 belonging to the adjacent rows (in the case shown the outer centre rows 4) towards the equatorial plane X-X according to a portion of lower width than that of the corresponding blocks 7.

In greater detail, each of the transverse slots 9a stretches out for about half the width of the respective block 7, according to an extension substantially parallel to that of the first cuts 8 bounding the block itself.

The presence of the transverse cuts 9a in the blocks 7 belonging to the outer centre rows 4 causes the amount of blocks present in said rows to be virtually increased, to the ends of a good operation of the tyres, as far as the achievement of a value included between the amount of blocks generated in the outer centre rows 4 by the presence

of the first cuts 8 and the amount of blocks generated in the inner shoulder rows 5 by the presence of the first and second cuts 8 and 9.

One or more of the block rows, in the case shown the outer shoulder rows 6, are also provided with third transverse cuts 10 extending parallel to the first and second transverse cuts 8, 9 at a suitably spaced apart position therefrom. The presence of the third cuts 10 in each outer shoulder row 6 substantially doubles the number of blocks 7a, 7b already defined therein by the presence of the first and second cuts 8, 9.

In particular, it has been ascertained that in order to have important and considerable advantages in a tread in accordance with the invention, the number of blocks present in the inner centre row 3 must preferably be included between 40 blocks maximum and 20 blocks minimum.

As can be viewed from Fig. 1, the extension of the longitudinal groove 2 intermediate between each of the outer 6 and inner 5 shoulder rows is provided to be interrupted according to an alternate sequence, at the end of each of the third cuts 10. Therefore, each of the outer shoulder rows 6 exhibits its linked blocks 7a formed of one piece construction with the blocks 7 belonging to the adjacent inner shoulder row 5 alternating with free blocks 7b which are at least partly disengaged from said blocks 7.

The third transverse cuts 10 preferably have a width "L'" which is smaller than that of the first and second transverse cuts 8, 9. In a preferential solution, each of the third cuts 10 along its axial extension has an inner portion 10a facing the equatorial plane X-X the width of which is preferably lower than 1 mm and an outer portion the width of which is greater than that of the inner portion 10a.

In known manner, the first, second and third transverse cuts 8, 9, 10 are also provided to be distributed in such a manner that the blocks 7 defined on the circumferential extension of the tread 1 have differentiated sizes alternating in a predetermined sequence, usually referred to as "stepped sequence", so that the acoustic energy produced following the tyre rolling on the road-bed is distributed according to a wide frequency range.

As previously said, the distribution of the above described first, second and third transverse cuts 8, 9, 10 is such that it enables the number of the blocks 7 associated with the individual centre rows 3, 4 and shoulder rows 5, 6 to gradually increase moving away from the equatorial plane X-X towards the side edges 1a of the tread 1.

Fig. 3 graphically shows the variation in the number of blocks 7 in the different rows 3, 4, 5, 6 defined on the tread width. In said figure, the lines denoted by A, B, C, D, E on the abscissa axis "a" correspond to width portions of the tread 1 com-

prised of the circumferential ribs 11, the inner centre rows 3, outer centre rows 4, inner shoulder rows 5 and outer shoulder rows 6. Numerically reproduced on the ordinate axis "b" are the amounts of the blocks arranged in the individual areas A, B, C, D, E, in relation to the number of the blocks provided in the inner centre rows 3 corresponding to areas B.

The chain lines C' referred to areas C show the virtual amount of the blocks 7 detectable in the outer centre rows 4 by effect of the first cuts 8 and slots 9a.

Advantageously, on varying the number of blocks from one row to the other, the longitudinal stiffness detectable at corresponding areas of the tread width varies correspondingly. As the graph in Fig. 2 clarifies, such a longitudinal stiffness gradually increases from the outer side edges 1a of the tread 1 towards the equatorial plane X-X, as far as its maximum value is reached at the circumferential ribs 11.

In accordance with the invention, such a variation of the longitudinal stiffness has been found to enable the rolling noise produced by the tyre with which the tread 1 is associated to be greatly reduced as compared with the known art, reference being particularly made to the noise transmitted to the outside of the motor-vehicle.

In the connection it has been found that the tread areas that are most liable to produce the outer noise are those closest to the equatorial plane X-X. In particular, at said areas the noise produced by rolling is particularly enhanced by rubbings and deformations undergone by the blocks during the transitory steps of contacts and separations with and from the road-bed at the contact area.

For better explaining why rubbings tend to be greater at the inner areas of the tread the following considerations become necessary.

One of the factors determining the importance of the rubbings undergone by the blocks is their contact pressure at the contact area.

It has been found that above all in the exit area from the contact area, where the separation of the blocks from the ground occurs, the contact pressure exerted by the blocks disposed close to the equatorial plane is much lower than that detectable in the blocks close to the outer edges 1a of the tread 1. Therefore, the blocks 7 disposed close to the centre areas will tend to undergo stronger rubbings than those close to the side edges 1a of the tread 1.

Another contributory factor in generating rubbings is represented by the acceleration undergone by the blocks 7 during the contact and separation steps with and from the contact area. As the value of such accelerations is a function of the square

radius according to which the blocks 7 are distributed about the tyre axis, the blocks closer to the equatorial plane X-X are those that undergo the greatest acceleration in that the tread 1, as known, has a convex outer profile in cross-section.

By virtue of the invention therefore it is possible to obviate the greater tendency to rubbing exhibited by the blocks 7 disposed in the areas close to the equatorial plane X-X by giving said blocks a greater longitudinal stiffness resulting from the bigger sizes of the latter, which in turn directly result from the smaller amount of blocks distributed over the circumferential extension of the tread in the centre rows 3, 4.

It is to be advantageously noted that the smaller number of blocks in the centre areas of the tread 1 does not greatly impair the tractive features of the tyre. Said features in fact mostly rely on the great number of blocks 7, 7a, 7b arranged in the shoulder rows 5, 6 where the greatest contact pressure and smallest tendency to rubbing are found.

Also the variation in the inclination of the transverse cuts 8 is advantageous for the purpose of reducing the outer rolling noise without jeopardizing the tractive features. In fact, the reduced angle " $\alpha$ " formed with the cuts 8 and longitudinal grooves 2 close to the centre rows 3, 4 greatly smooths the impact of the blocks 7 onto the ground, exactly at the areas on which the outer noise most depends. On the contrary, the cuts 8 take an orientation perpendicular to the longitudinal grooves 2 and therefore to the running direction at the areas close to the side edges where the outer noise effects are felt the least and the tractive features are of great importance.

Obviously, many modifications and variations may be made to the invention as conceived, all of them falling within the scope of the inventive idea characterizing it.

In particular, the tread pattern shown in Fig. 1, referring particularly to the transverse grooves, is symmetric but said tread may also have an asymmetric pattern or a pattern showing mirror images on the two sides of the equatorial plane X-X.

Obviously in manufacturing the tread of the invention the possibility of adopting other expedients already provided by the known art for reducing the rolling noise is not excluded.

## Claims

1. A tyre for motor-vehicle wheels provided with a tread producing a low rolling noise, comprising a raised pattern formed of a plurality of shaped blocks (7) distributed in parallel circumferential rows (3, 4, 5, 6) bounded by longitudinal grooves (2) extending circumferentially of the

- tyr and each comprising a given number of shaped blocks (7) separated from each other by respective transverse cuts (8, 9, 10), characterized in that in said tread each of said rows has an amount of shaped blocks (7) greater than the amount of shaped blocks (3, 4, 5, 6) present in the row disposed consecutively in side by side relation therewith towards the equatorial plane (X-X) of the tread (1), in order to give the tread a gradually increasing longitudinal stiffness from the outer side edges (1a) thereof towards said equatorial plane (X-X).
2. A tyre according to claim 1, characterized in that the number of said block rows on each centre line of the tread is not smaller than three and not greater than five.
  3. A tyre according to claim 1, characterized in that at least one continuous circumferential rib (11) is disposed close to the equatorial plane (X-X), said rib being delimited between two of said longitudinal grooves (2).
  4. A tyre according to claim 3, characterized in that it comprises two of said circumferential ribs (11) disposed symmetrically with respect to the equatorial plane (X-X) of the tread (1) and mutually separated by a central groove (12).
  5. A tyre according to claim 1, characterized in that the number of said shaped blocks in the axially innermost row is in the range of 20 to 40.
  6. A tyre according to claim 1, characterized in that the number of said shaped blocks doubles on passing from one row to that disposed consecutively in side by side relation therewith, in the axial direction towards the outside.
  7. A tyre according to claim 1, characterized in that in each row (3, 4, 5, 6) of said shaped blocks the transverse cuts (8, 9, 10) define an impact angle ( $\alpha$ ) with the adjacent longitudinal grooves (2) the width of which is greater than the width of the impact angle formed with the transverse cuts of the block row disposed consecutively in side by side relation therewith towards the equatorial plane (X-X).
  8. A tyre according to claim 7, characterized in that the value of the impact angle ( $\alpha$ ) in the block rows (3) that are closest to the equatorial plane (X-X) is in the range of 15° to 25°.
  9. A tyre according to claim 7, characterized in that the value of the impact angle ( $\alpha$ ) in the block rows (6) closest to the side edges (1a) of the tread (1) is in the range of 70° to 105°.
  10. A tyre according to claim 1, characterized in that each of said rows (3, 4, 5, 6) has first transverse cuts (8) each extending consecutively of one of the first transverse cuts belonging to the block row disposed adjacently in side by side relation.
  11. A tyre according to claim 10, characterized in that said first cuts (8) consecutively aligned define continuous transverse grooves (13) each extending from the corresponding outer side edge (1a) of the tread (1) as far as close to said equatorial plane (X-X).
  12. A tyre according to claim 10, characterized in that each of said transverse grooves (13), starting from the corresponding outer side edge (1a) has one straight portion substantially perpendicular to the longitudinal grooves (2), a curved union portion and a second straight portion disposed obliquely relative to said longitudinal grooves (2).
  13. A tyre according to claim 11, characterized in that said longitudinal grooves (2) have a smaller width than the first transverse cuts (8).
  14. A tyre according to claim 12, characterized in that the ratio between the width of the longitudinal grooves (2) and the width of the first transverse cuts (8) ranges between 0.6 and 0.2.
  15. A tyre according to claim 10, characterized in that at least one of said block rows (5, 6) has second transverse cuts (9) each of them being intermediate between two of said first cuts (8).
  16. A tyre according to claim 15, characterized in that the second cuts (9) are associated with outer shoulder rows (6), adjacent to the outer side edges (1a) of the tread (1), and inner shoulder rows (5) disposed side by side with the outer shoulder rows (6) towards the equatorial plane (X-X).
  17. A tyre according to claim 15, characterized in that the width of the second cuts (9) is smaller than the width of the first cuts (8).
  18. A tyre according to claim 17, characterized in that the ratio between the width of the second cuts (9) and the width of the first cuts (8)

ranges between 0.5 and 1.

19. A tyre according to claim 15, characterized in that the shaped blocks (7) of at least one of said rows (4) have each at least one transverse slot (9a) extending towards said equatorial plane (X-X) over a portion of lower width than the width of the block itself, in the extension of one of said second cuts (9). 5
20. A tyre according to claim 19, characterized in that said transverse slots (9a) are associated with outer centre rows (4) disposed consecutively and side by side with the inner shoulder rows (5) towards the equatorial plane (X-X) of the tread (1). 10 15
21. A tyre according to claim 15, characterized in that at least one of said block rows (6) further comprises third transverse cuts (10) extending parallel to said first and second transverse cuts (8, 9). 20
22. A tyre according to claim 21, characterized in that said third transverse cuts (10) are associated with outer shoulder rows (6) adjacent to the outer side edges (1a) of the tread. 25

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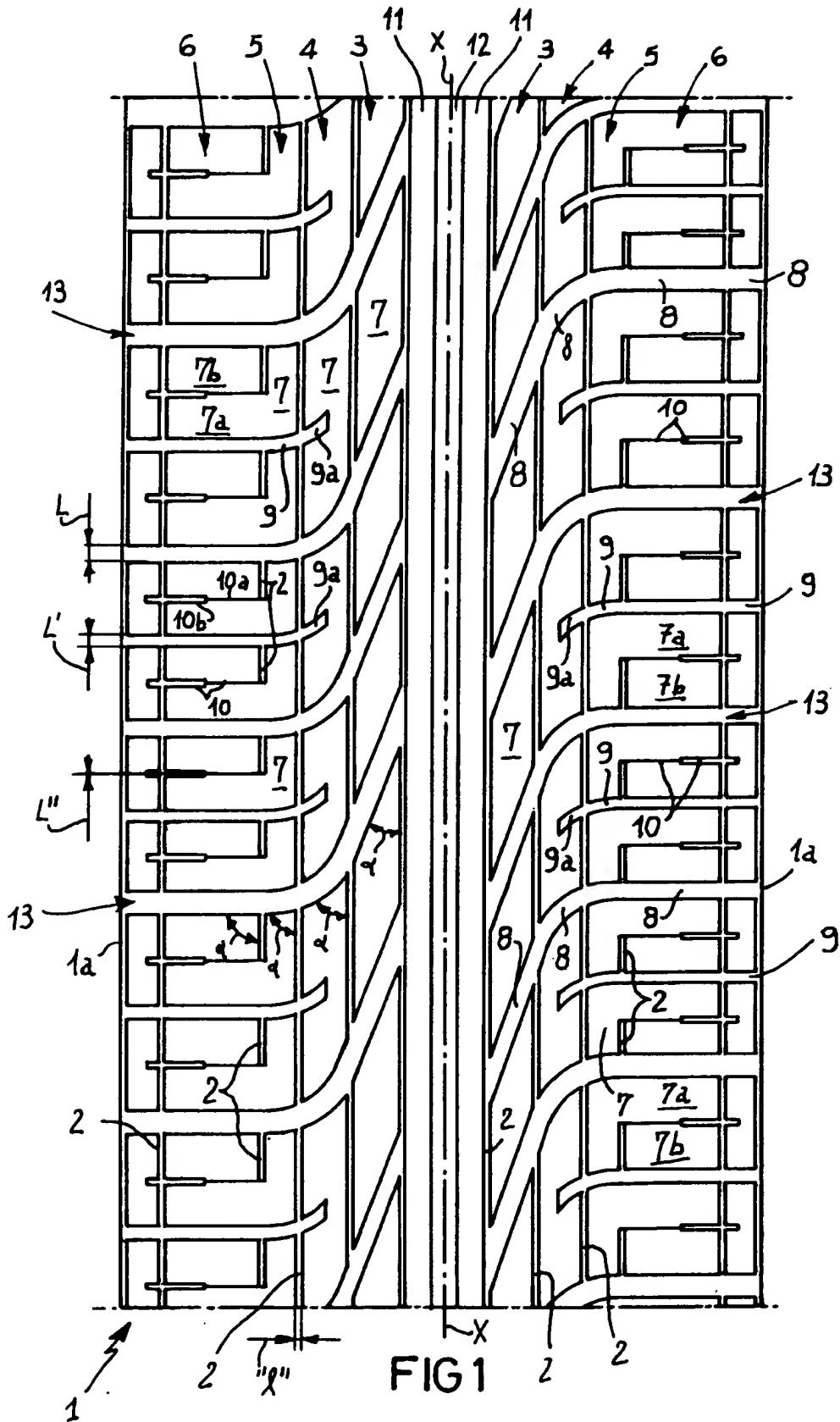
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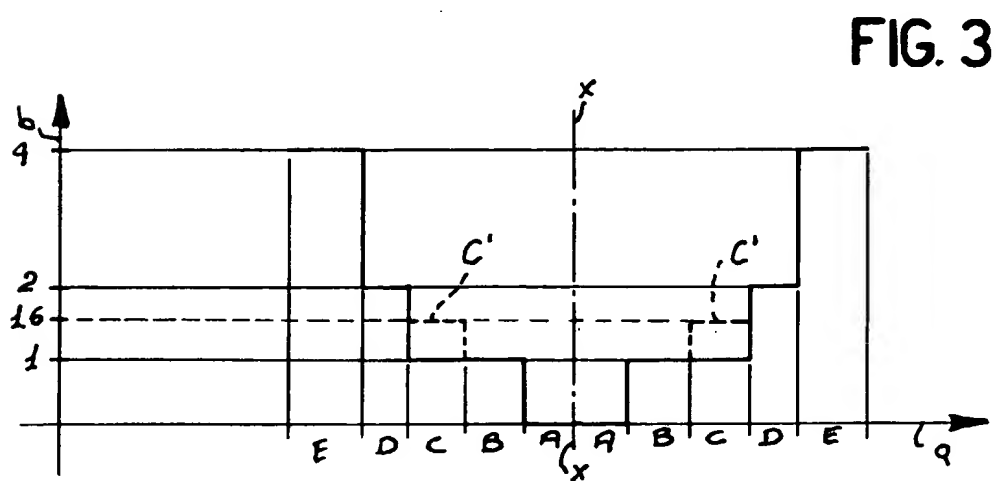
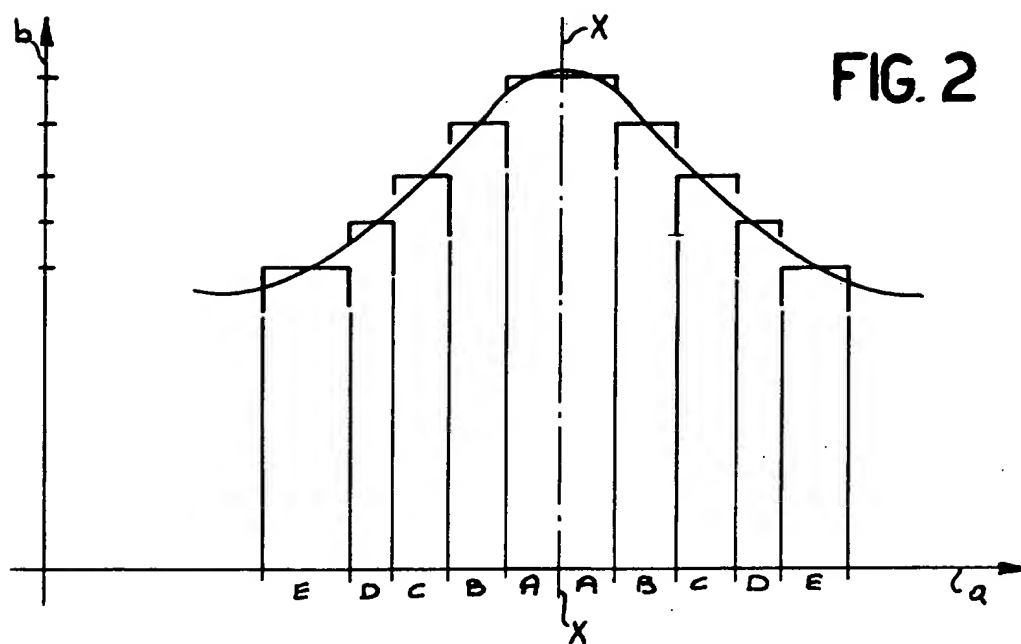
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European Patent  
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## EUROPEAN SEARCH REPORT

Application Number  
EP 94 10 7942

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 5)
X	PATENT ABSTRACTS OF JAPAN vol. 17, no. 139 (M-1385) 22 March 1993 & JP-A-04 317 805 (BRIDGESTONE CORP.) 9 November 1992 * abstract *	1-11	B60C11/04 B60C11/03
X	PATENT ABSTRACTS OF JAPAN vol. 8, no. 166 (M-314) (1603) 2 August 1984 & JP-A-59 063 206 (BRIDGESTONE KK.) 10 April 1984 * abstract *	1-3,5,6	
A	EP-A-0 475 929 (SEMPERIT AG.) * claims; figures *	1-7	
A	US-A-4 936 364 (S. KAJIWARA ET AL.) * claims; figures *	1	
A	DE-U-90 05 029 (THE GOODYEAR TIRE & RUBBER CO.) * claims; figures *	8-12	
A D	EP-A-0 457 233 (PIRELLI) & IT-A-9020284A (...)	1	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 19 August 1994	Examiner Baradat, J-L
<b>CATEGORY OF CITED DOCUMENTS</b>			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- Δ : member of the same patent family, corresponding document	